CLAIMS

1. A method of desalinating water in a plurality of stages at which respective membrane module units are disposed, wherein permeate water from a first stage membrane module unit is supplied to a second stage membrane module unit to obtain desalinated permeate water therefrom, the method comprising:

a first step of processing feed water having a total salt concentration of 3.0 to 4.8 % by weight and a calcium ion concentration of 200 to 500 mg/l, in which first step at least a proportion of the feed water is treated with the first stage membrane module unit, to obtain the permeate water and which permeate water is optionally mixed with additional feed water, the water thus processed in the first step thereby having a total salt concentration of 55 to 90% of that of the feed water and a calcium ion concentration of 95% or less of that of the feed water; and

a second step of supplying the water processed by the first step to the second stage membrane module unit, thereby obtaining the desalinated water.

2. A method according to Claim 1, wherein the feed water has a sulphate ion concentration of 1500 to 3500 mg/l and the sulphate concentration is adjusted to 80% or less of that of the feed water by the first step.

3. A method according to Claim 1, wherein 30 to 100% of the amount of the feed water is treated with the first stage membrane module unit, and then mixed with untreated feed water and supplied to the second stage membrane module unit.

4. A method according to Claim 3, wherein 35 to 95% of the amount of the feed water is treated with the first stage membrane module unit, and then mixed with untreated feed water and supplied to the second stage membrane module unit.

5. A method according to Claim 4, wherein 40 to 90% of the amount of

the feed water is treated with the first stage membrane module unit, and then mixed with untreated feed water and supplied to the second stage membrane module unit.

6. A method according to Claim 1, carried out such as to provide, from the water supplied to the first stage membrane module unit, permeate water and concentrate water, the amount of permeate water, expressed as a percentage of the total amount of water supplied, being within the range of 65% to 95%.

7. A method according to Claim 6, wherein the said percentage amount of permeate water is within the range of 75% to 90%.

8. A method according to Claim 1, carried out such as to provide, from the water supplied to the second stage membrane module unit, permeate water and concentrate water, the percentage amount of permeate water, expressed as a percentage of the total amount of water supplied, being within the range of 70% to 85%.

9. A method according to Claim 1, carried out such that the total amount of permeate water from the second stage membrane module unit, expressed as a percentage of the amount of feed water (so-called total recovery ratio), is within the range of 60% to 80%.

10. A method according to Claim 9, wherein the said percentage amount of permeate water from the second stage membrane module unit is within the range of 65% to 75%.

11. A method according to Claim 1, wherein a nanofiltration membrane unit is used for the first stage membrane module unit and a reverse osmosis membrane unit is used for the second stage membrane module unit.

12. A method according to Claim 11, wherein the first stage nanofiltration membrane module unit has at least first and second membrane components at respective first and second sub-stages of the first stage, each said membrane component providing permeate water and concentrate water and wherein concentrate water from a first sub-stage nanofiltration membrane module component is supplied to a second sub-stage nanofiltration membrane module component.

13. A method according to Claim 11, wherein the second stage reverse osmosis membrane module unit has at least first and second membrane components at respective first and second sub-stages of the second stage, each said membrane component providing permeate water and concentrate water and wherein concentrate water from a first sub-stage reverse osmosis membrane module component is supplied to a second sub-stage reverse osmosis membrane module component.

14. A method according to Claim 13, wherein the pressure of concentrate water from the first sub-stage reverse osmosis membrane module component is boosted and the concentrate water then supplied to the second sub-stage reverse osmosis membrane module component to obtain desalinated water.

15. A method according to Claim 14, wherein, in a plurality of sub-stages at which reverse osmosis membrane module components are disposed, the relation between the operating pressure P(n) of the first sub-stage reverse osmosis membrane module component and the operating pressure P(n + 1) of the second sub-stage reverse osmosis membrane module component is in a range given by the expression

$15 \leq P(n + 1) / P(n) \leq 1.8$.

16. A method according to any one of Claims 11, wherein a scale prevention agent is injected into the water supplied to the nanofiltration membrane module unit before performing nanofiltration.

17. A method according to Claim 1, wherein the feed water is filtered water processed with a microfiltration membrane or an ultrafiltration membrane.

18. A desalination apparatus comprising:

at least first and second membrane module units at respective successive first and second stages for water permeation,

as a said first membrane unit at the first stage, a nanofiltration membrane module unit having a membrane module and an outlet channel for water permeated thereby,

as a said second membrane unit at the second stage, a reverse osmosis membrane module unit disposed in the outlet channel of the nanofiltration membrane module unit, for permeated water; and

means for diverting a proportion of feed water supplied to the nanofiltration membrane module unit directly to the said outlet channel thereof so as to bypass the membrane module thereof.

19. A desalination apparatus according to claim 18, wherein the outlet channel of the nanofiltration membrane module unit has means for mixing the said diverted proportion of feed water with water permeated by the nanofiltration membrane module unit at the first stage upstream of the reverse osmosis membrane module

unit at the second stage.

20. A desalination apparatus according to Claim 18, wherein the first stage membrane module unit is a nanofiltration membrane module unit having at least one first membrane component and at least one second membrane component at respective successive first and second sub-stages of the said first stage, each said membrane component being capable of providing permeate water and concentration water and wherein a second sub-stage nanofiltration membrane module component is disposed in a concentrate water outlet channel of a first sub-stage nanofiltration membrane module component.

21. A desalination apparatus according to Claim 20, wherein the relation between the total membrane surface area S1(n) of the or each said first sub-stage nanofiltration membrane module component and the total membrane surface area S1(n + 1) of the or each said second sub-stage nanofiltration membrane module component is in a range given by the expression
$1.5 \leq S1(n) / S1(n + 1) \leq 5$.

22. A desalination apparatus according to Claim 20, wherein the second stage membrane module unit is a reverse osmosis membrane module unit having at least one first membrane component and at least one second membrane component at respective successive first and second sub-stages of the said second stage, each said membrane component being capable of providing permeate water and concentrate water, and wherein a second sub-stage reverse osmosis membrane module component is disposed in a concentrate water outlet channel of a first sub-stage reverse osmosis membrane module component.

23. A desalination apparatus according to Claim 22, wherein the relation between the total membrane surface area S2(n) of the or each said first sub-stage

reverse osmosis membrane module component and the total membrane surface area S2(n + 1) of the or each said second sub-stage reverse osmosis membrane component module is in a range given by the expression $1.67 \leq S2(n) / S2(n + 1) \leq 2.5$.

24. A desalination apparatus according to Claim 22, wherein boosting means for boosting the pressure of the concentrate water are disposed in the concentrate water outlet channel of at least a first reverse osmosis membrane module component at a first sub-stage of the second stage.

25. A desalination apparatus according to Claim 18, wherein scale prevention agent injecting means are disposed in a feed water channel upstream of the nanofiltration membrane module unit.

26. A desalination apparatus according to Claim 18, wherein a microfiltration membrane module unit or an ultrafiltration membrane module unit is disposed in a feed water channel upstream of the nanofiltration membrane module unit.